



Predicting Future Habitat Changes and Habitat Use in Northwest Alaska

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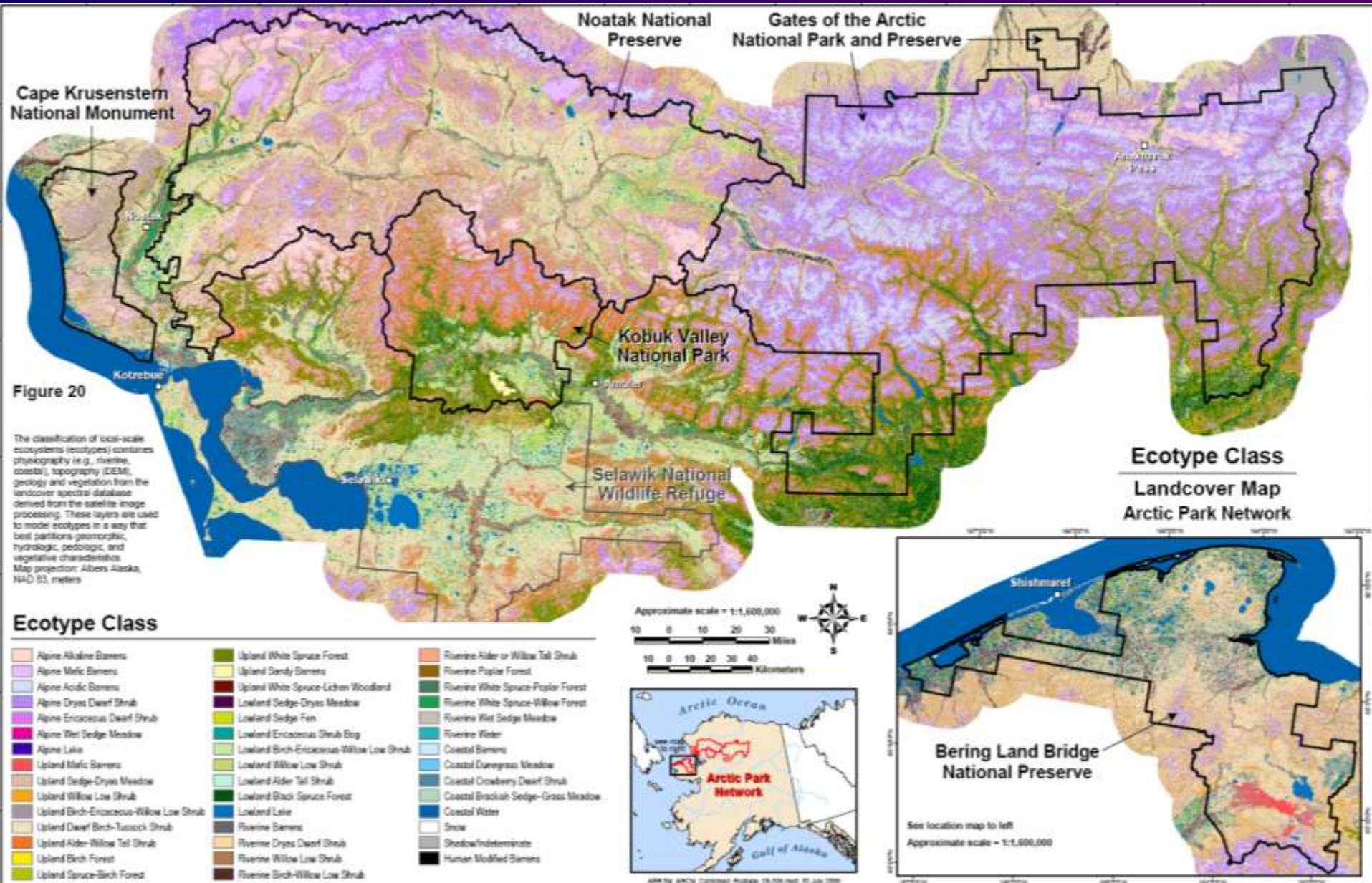
Bruce Marcot, U.S. Forest Service

Wildcast Project, USGS Alaska Science Center

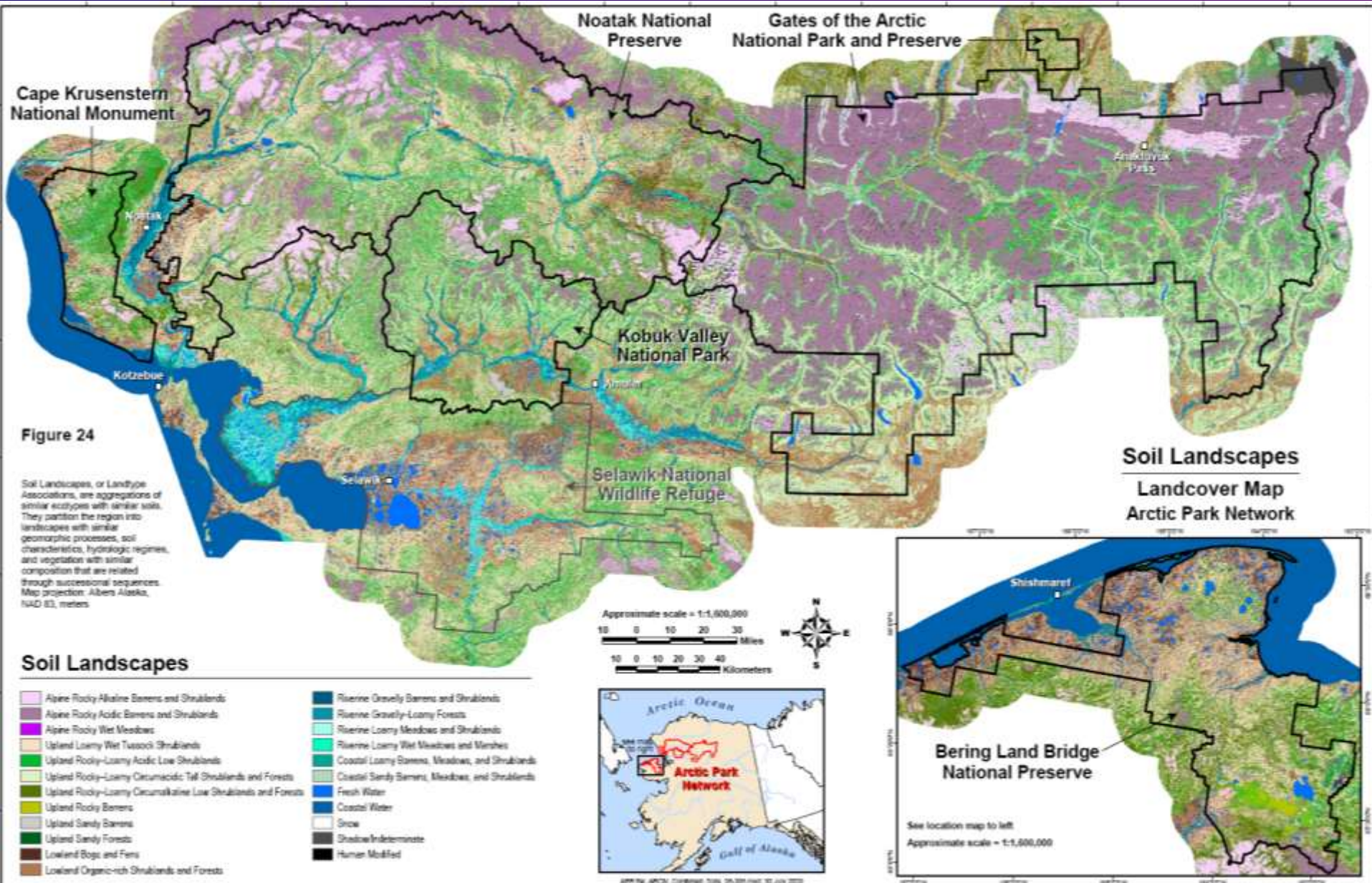
Assessment Approach

- **Ecological Classification**
 - Local and Landscape-Level Ecosystems
- **Conceptual Modeling**
 - Process and Pathway Models
- **Monitoring (nice to have some field data)**
- **Landscape Change Analysis (time-series analysis of historical airphotos)**
- **General Predictions (Transition Probabilities)**

Ecosystems Map for ARCN



Ecological Aggregation



Arctic Landform-Vegetation-Permafrost Relationships

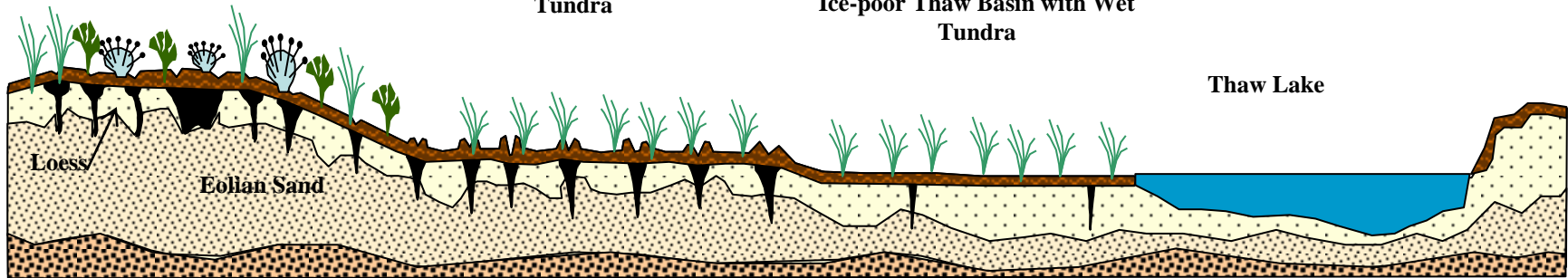
Arctic Coastal Plain

Coastal Plain with Moist/ Dry
Tundra

Ice-rich Thaw Basin with Wet
Tundra

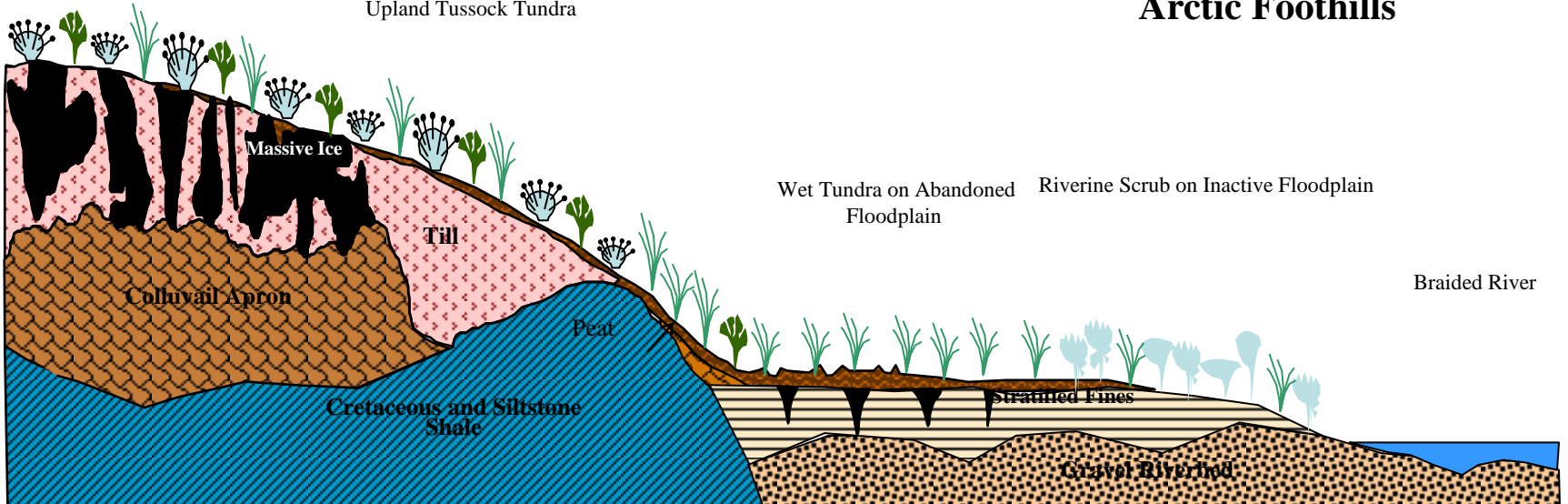
Ice-poor Thaw Basin with Wet
Tundra

Thaw Lake



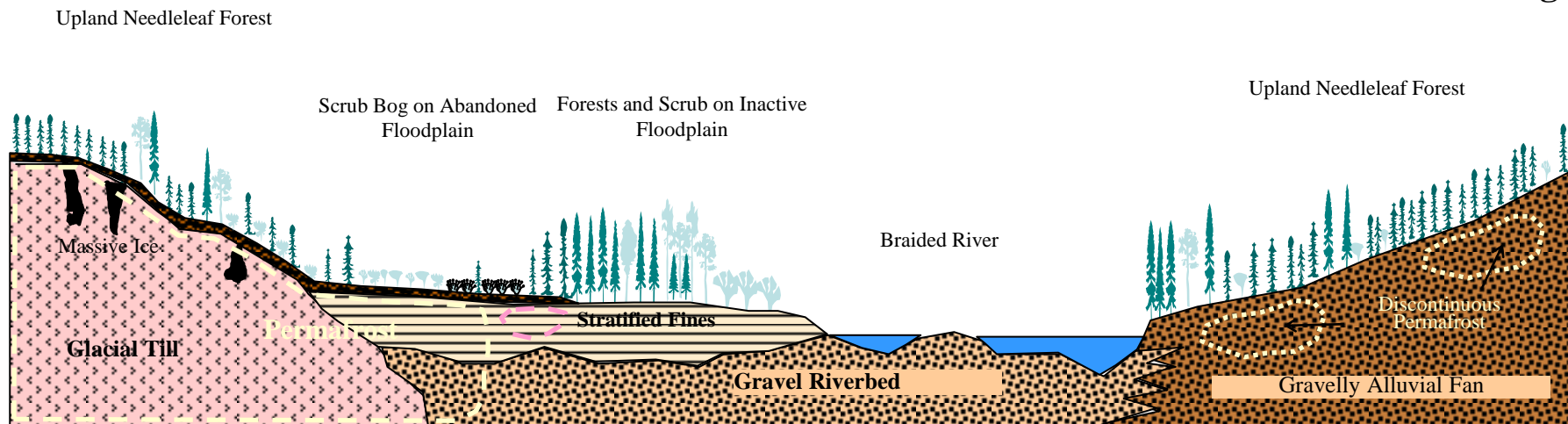
Upland Tussock Tundra

Arctic Foothills



Boreal Landform-Vegetation-Permafrost Relationships

Brooks Range

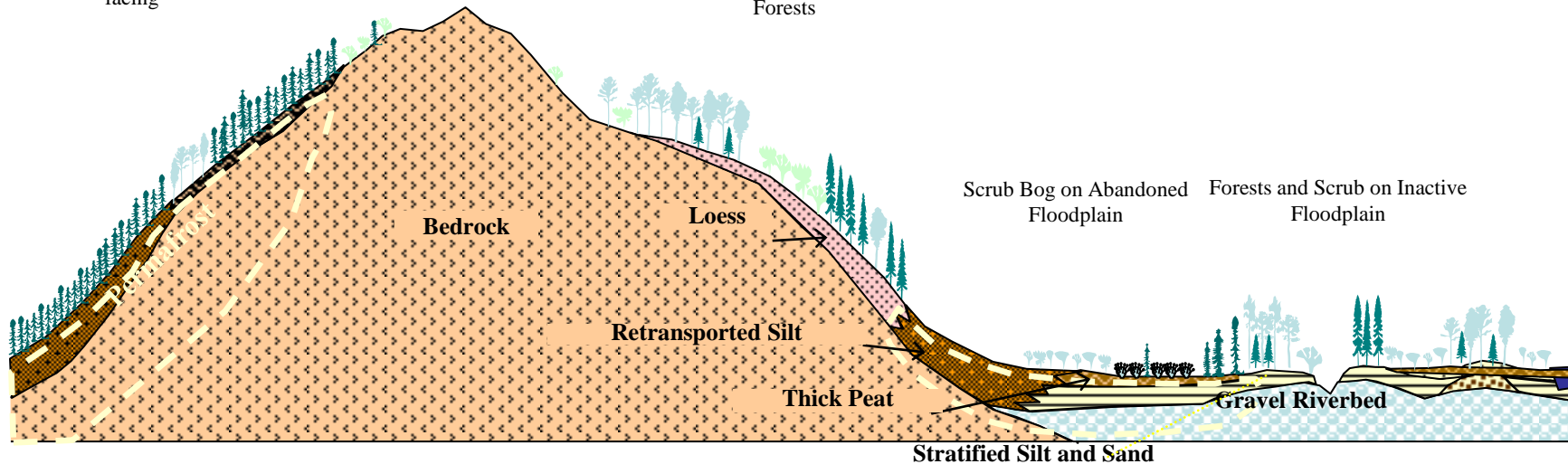


Alpine Tundra

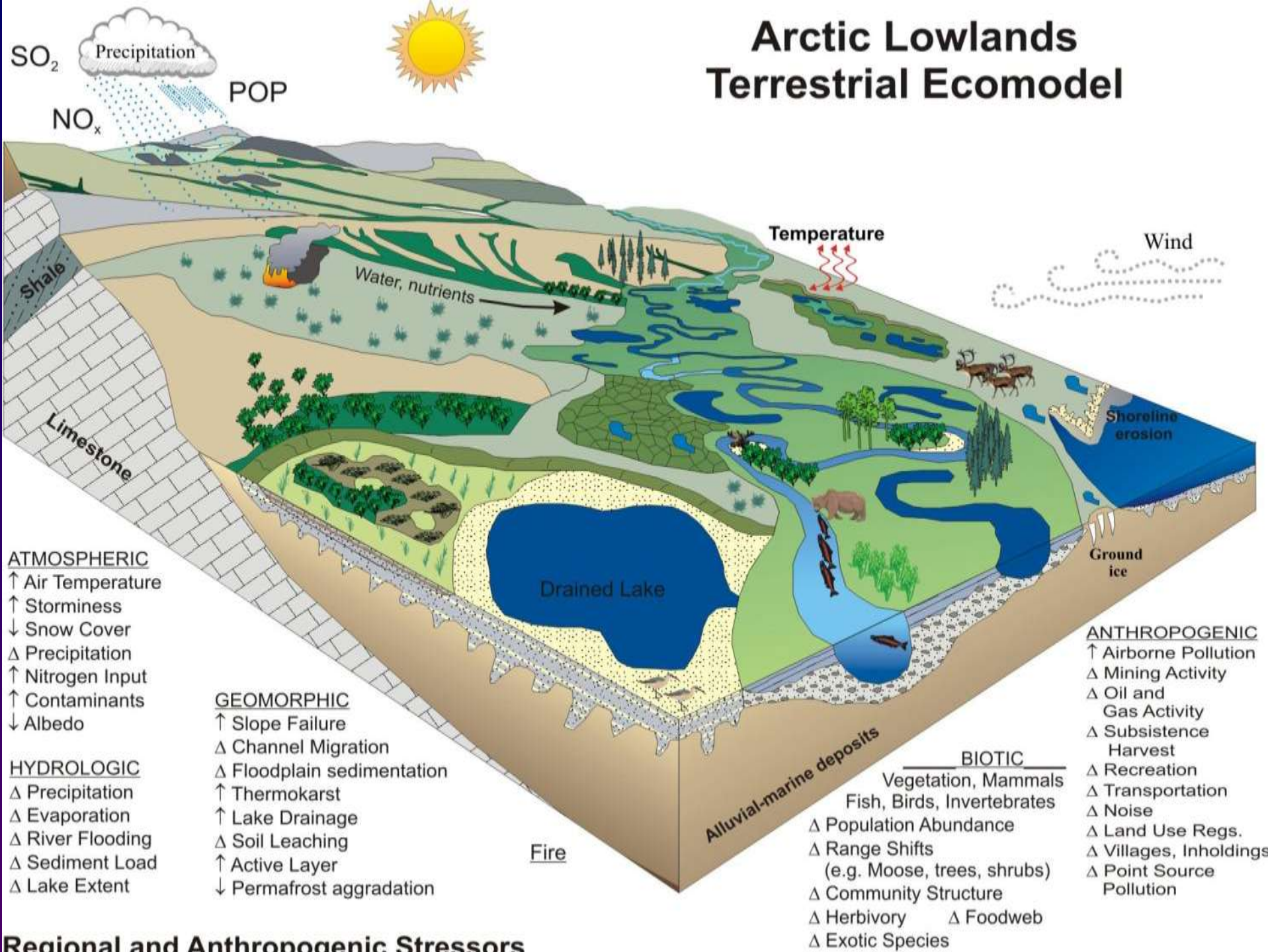
Upland Needleleaf Forest, North-facing

Upland Needleleaf and Broadleaf Forests

Interior Forests

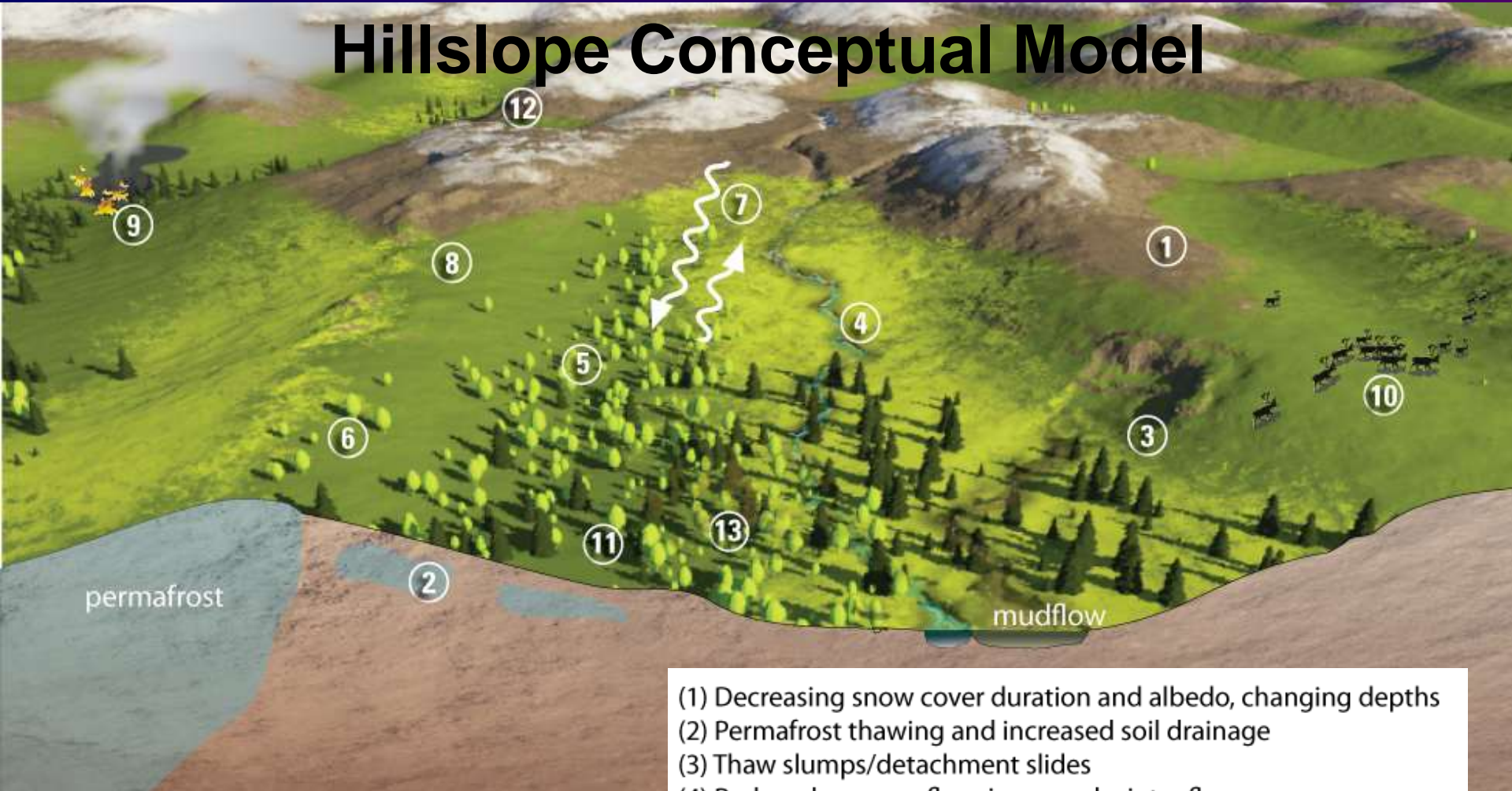


Arctic Lowlands Terrestrial Ecomodel



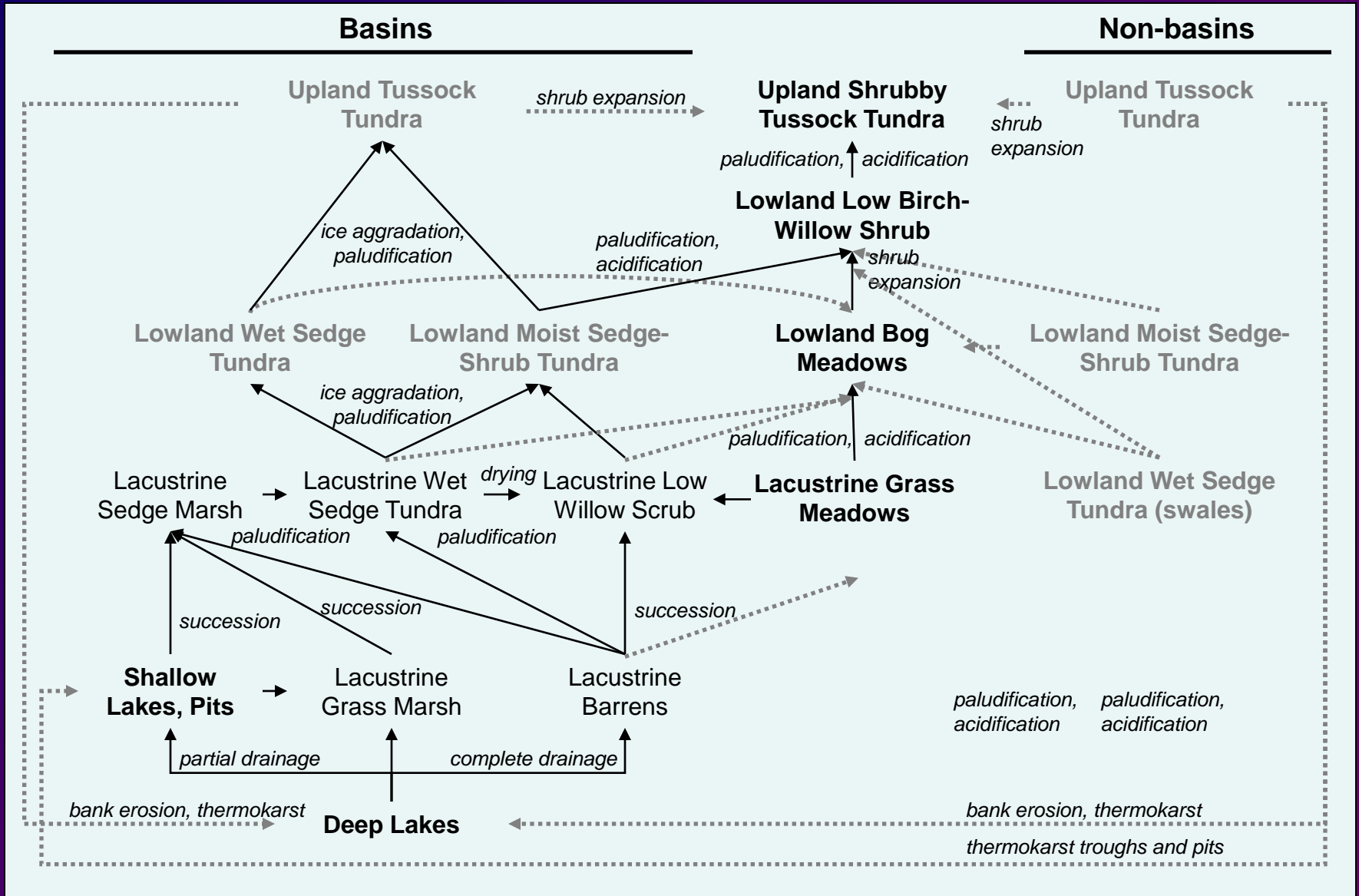
Regional and Anthropogenic Stressors

Hillslope Conceptual Model



- (1) Decreasing snow cover duration and albedo, changing depths
- (2) Permafrost thawing and increased soil drainage
- (3) Thaw slumps/detachment slides
- (4) Reduced summer flow, increased winter flow
- (5) Longer growing seasons
- (6) Forest and shrub expansion
- (7) Lower albedo, atmospheric feedback
- (8) Changing lichen abundance
- (9) Increased fires
- (10) Animal range shifts
- (11) Changing forest and shrub structure for birds
- (12) Altitudinal vegetation zone shifts
- (13) Increasing insect infestations and disease

Coastal Plain Pathways



KEY PROCESSES

**Thaw Lakes
Thaw Slump
Lake Drainage
Landslides/Fans
Soil Drainage
Drying
Sedimentation
Glacier melting
Fire
Acidification-leaching
Paludification
Primary succession
Secondary succession
Dominance shift
Plant migration
Channel erosion
Coastal erosion
Drainage/Migration
Human development
Thaw settlement**

Disturbance

Fire



Historical Fire Perimeters

Arctic Park Network
Inventory & Monitoring Program

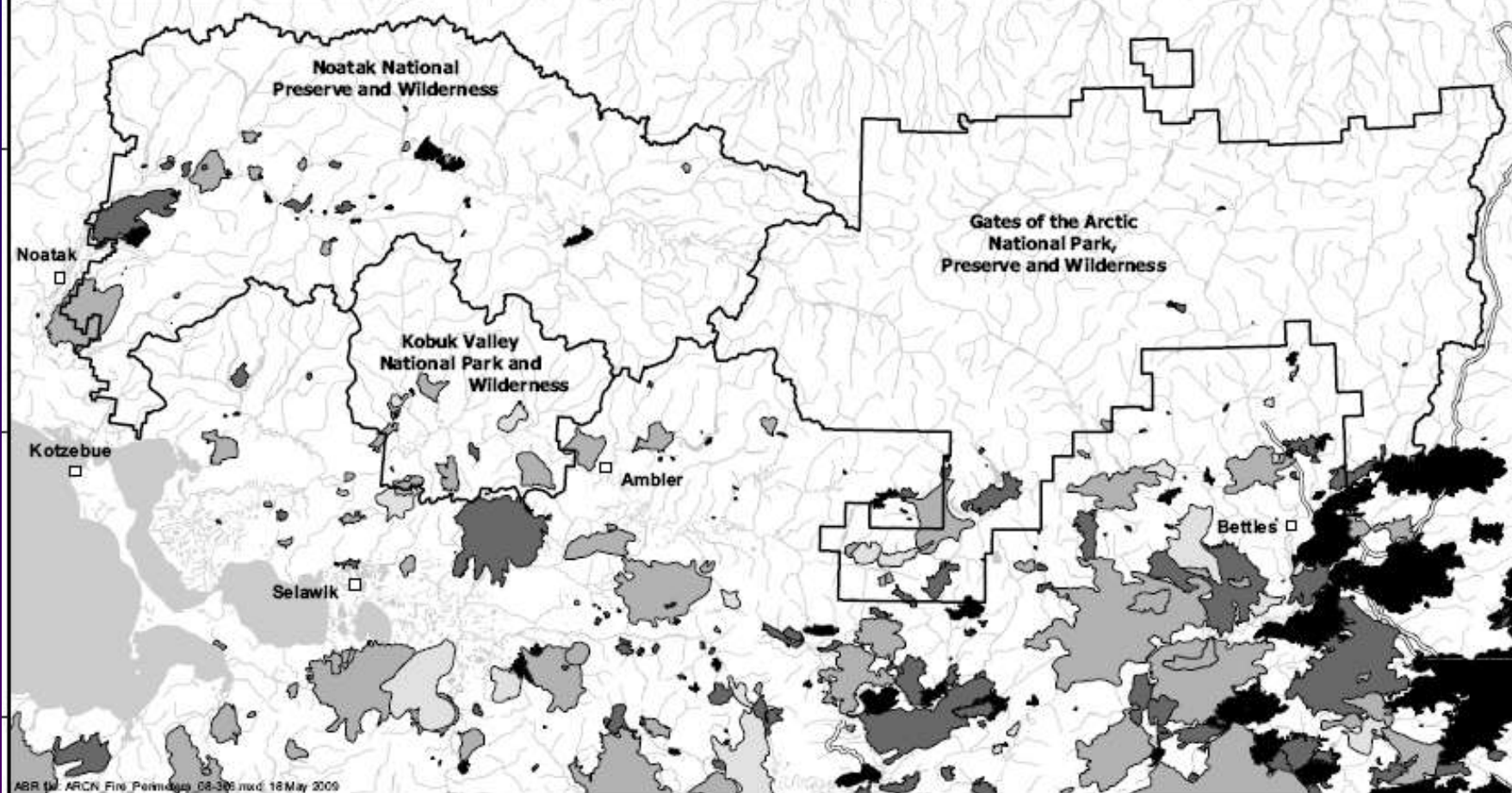
Year of Fire

-  1942-1959
-  1960-1979
-  1980-1999
-  2000-2007

Approximate scale: 1:2,250,000

20 0 20 40 60 Kilometers

10 0 10 20 30 40 Miles



Thermokarst

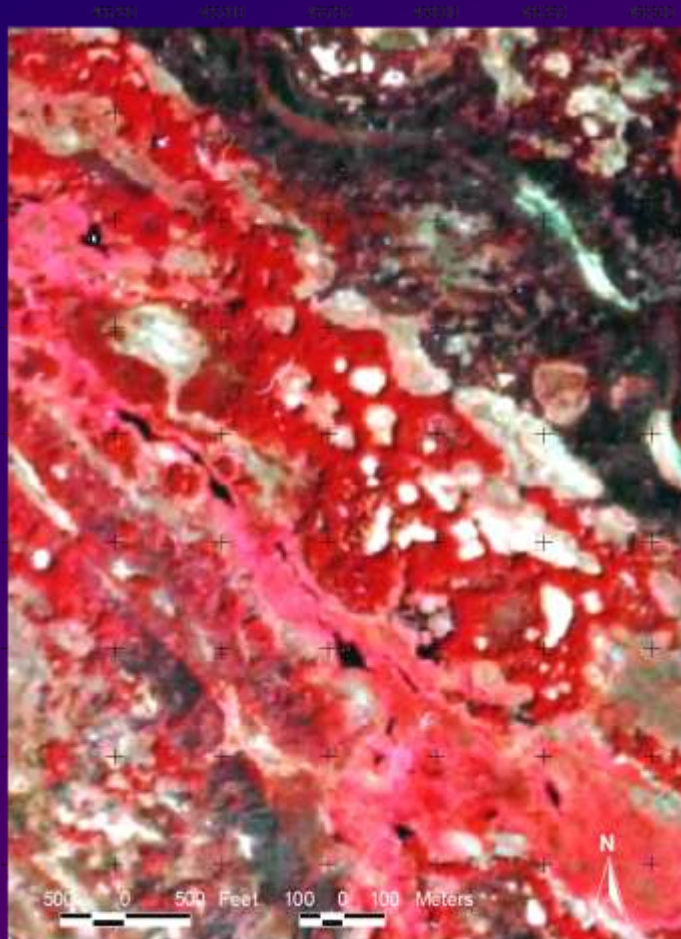


Shrub and Forest Expansion



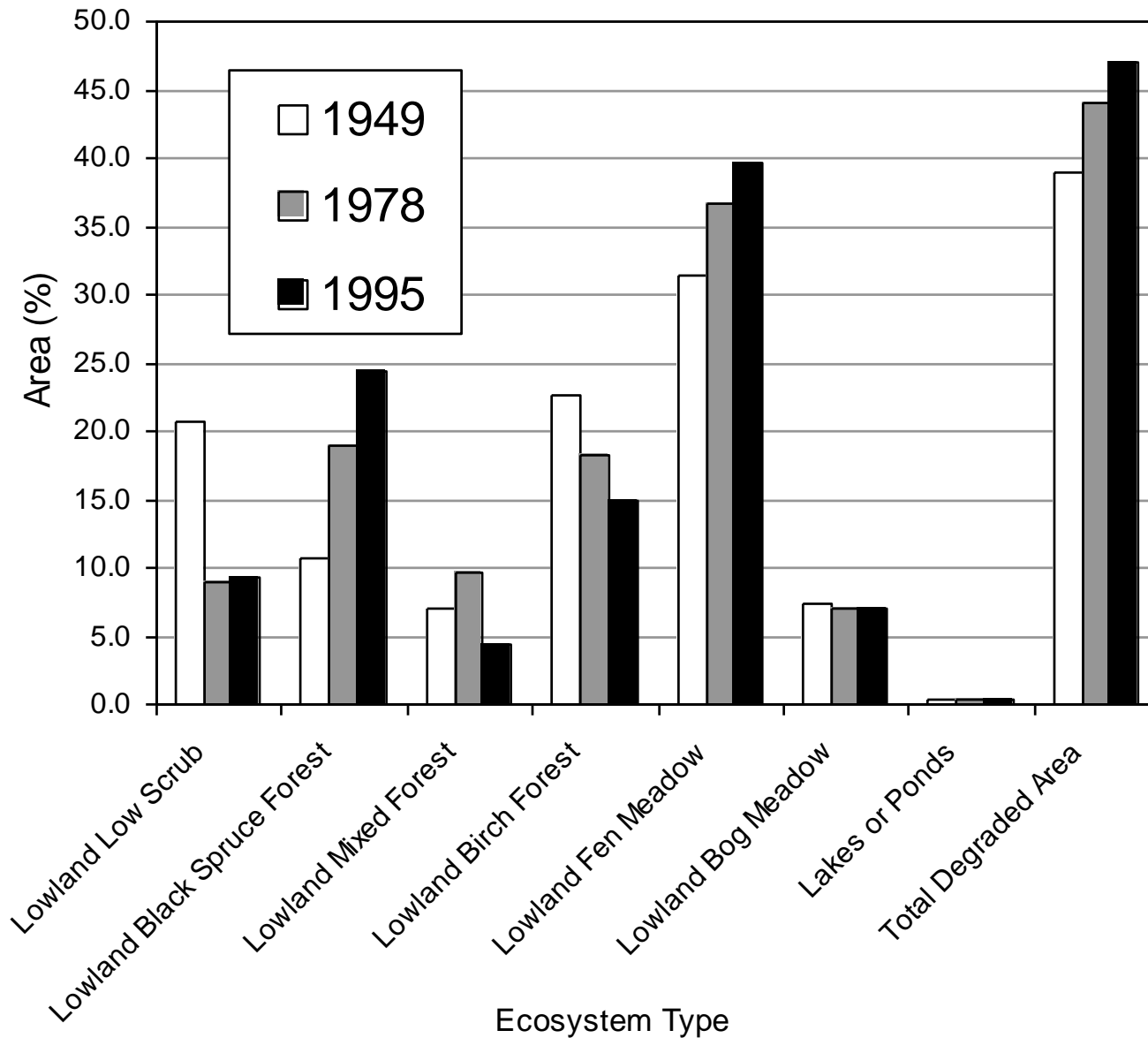
Historical Rates of Change

1978



1995





Repeat Photography

Lichen Loss and Shrub Increase– Noatak Basin

1909 – Phillip Smith





2006 Photo by Torre Jorgenson

1909 – Phillip Smith





2006 Photo by Torre Jorgenson

NPRA

MAAT = -12 C

Cautionary Tales

MAAT = -6 C

**Seward
Peninsula**

MAAT = +2 C

King Salmon

**High resilience of
tussock tundra**

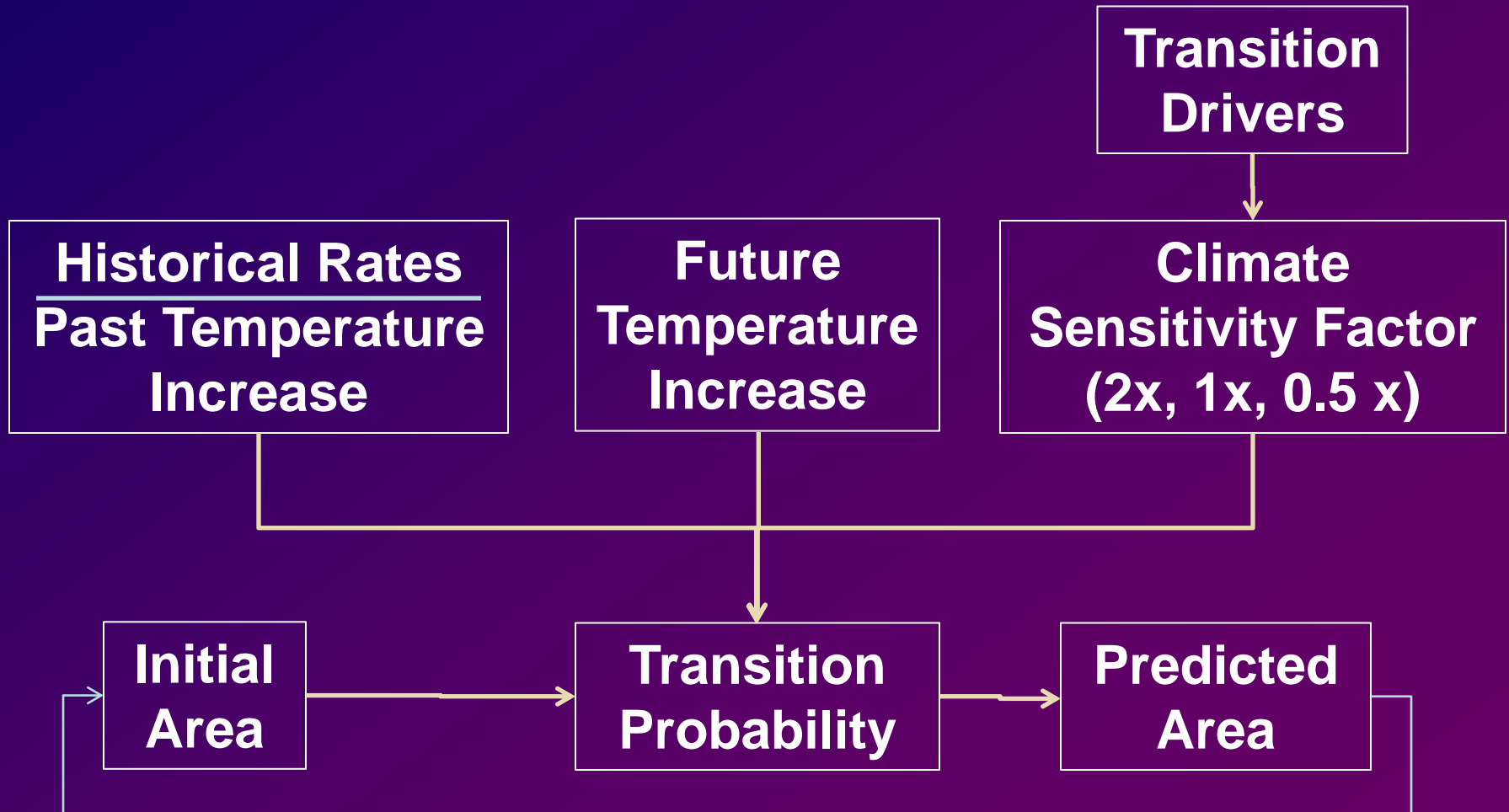
Floodplains as Migration Corridors



Alder on Lower Colville Floodplain



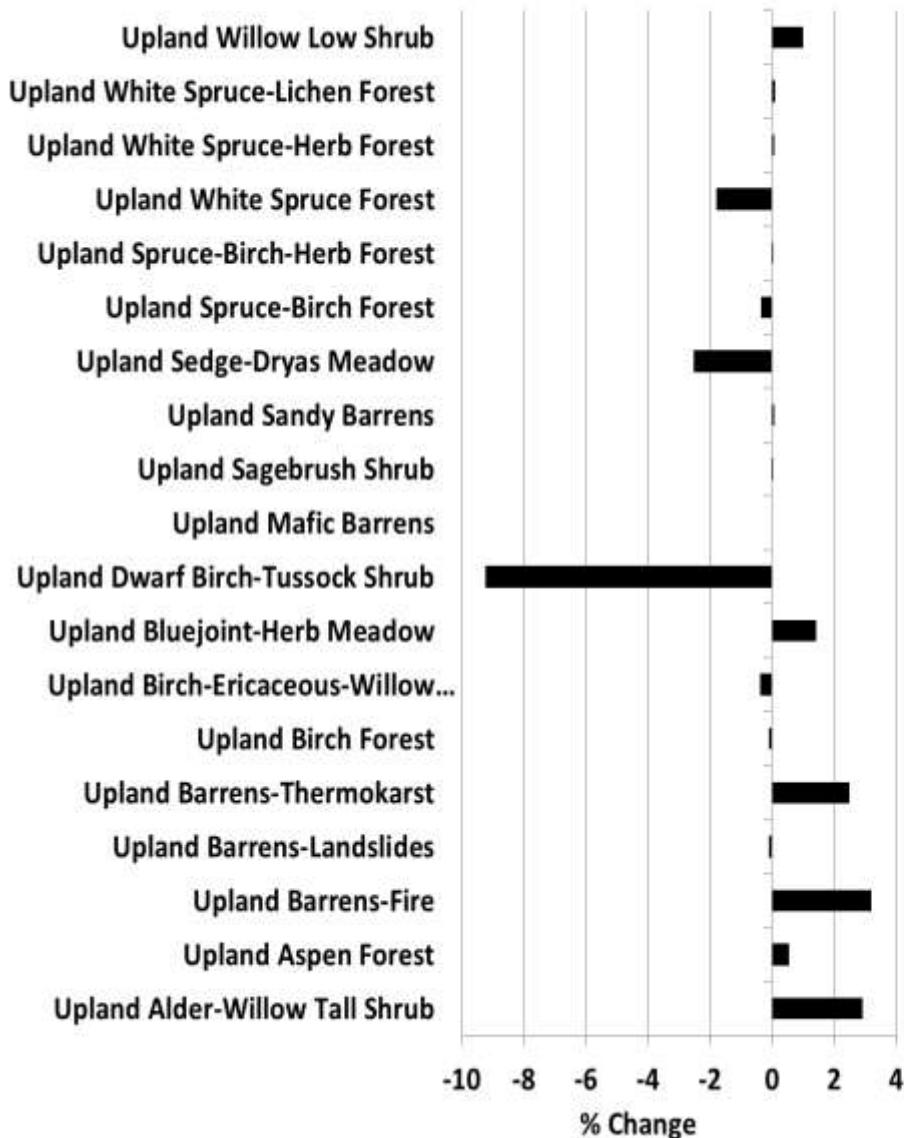
Modeling Change with Transition Probabilities



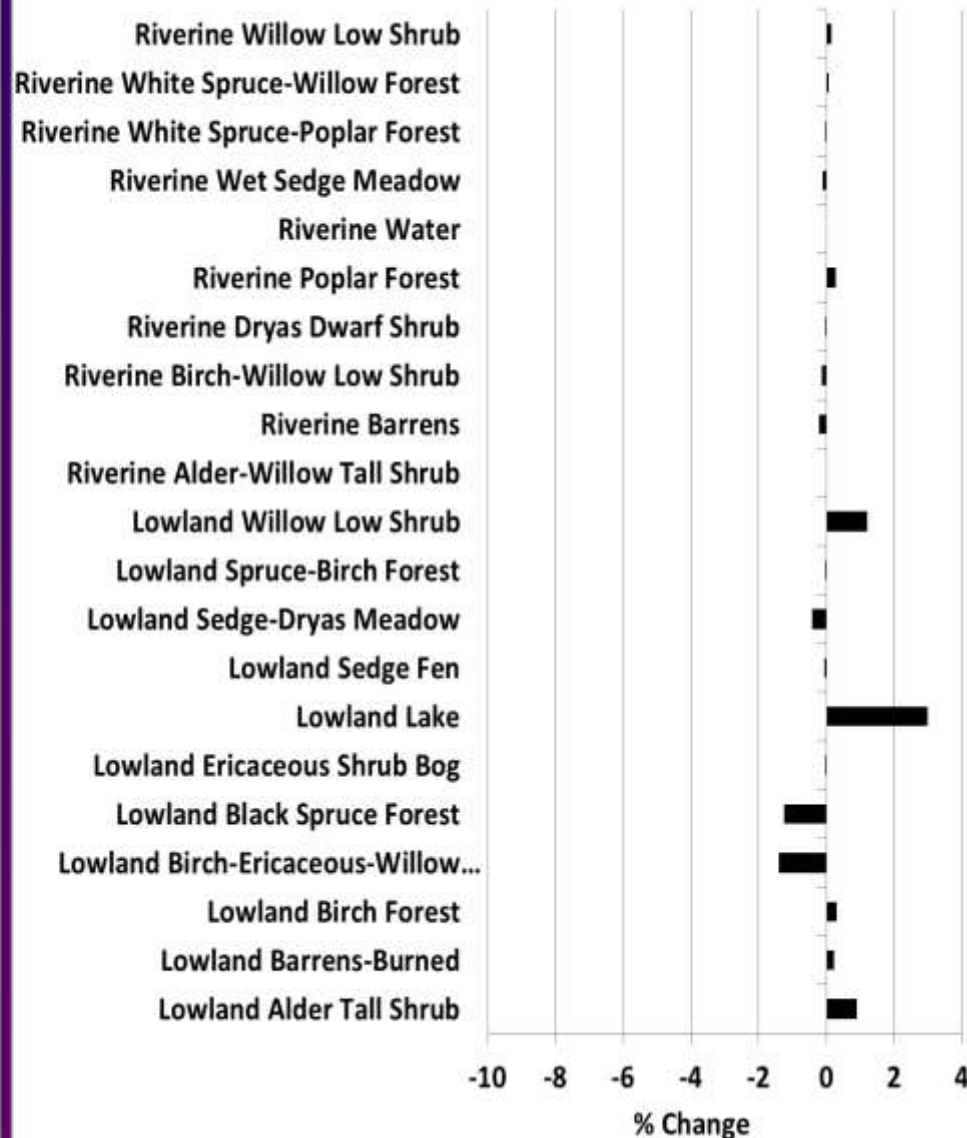
Alpine glaciers high sensitivity with positive feedbacks, 2x
Riverine tall shrub, low sensitivity dominated by numerous other factors, 0.5x

Predicted Ecosystem changes, 2000-2100

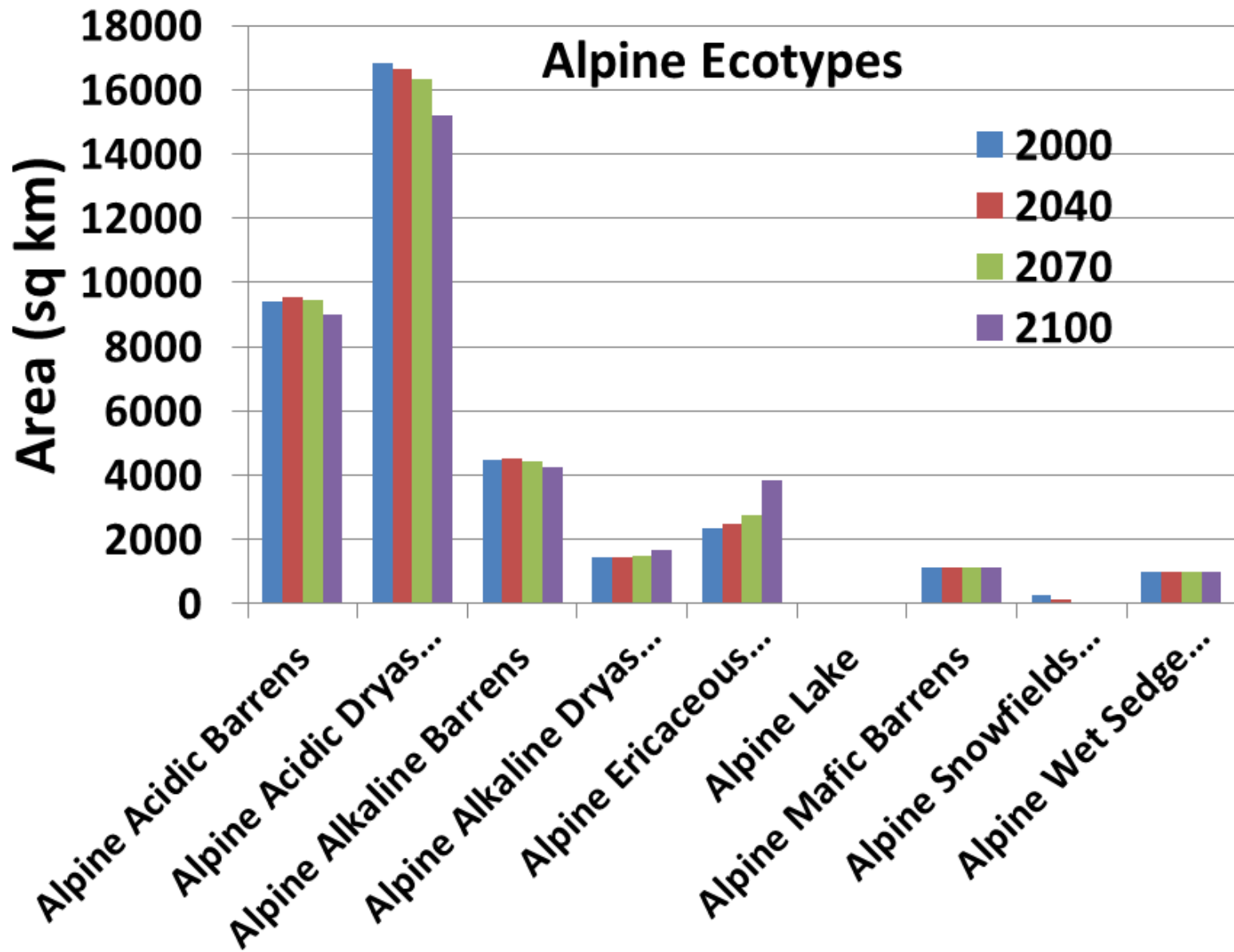
Upland Change, 2000-2100



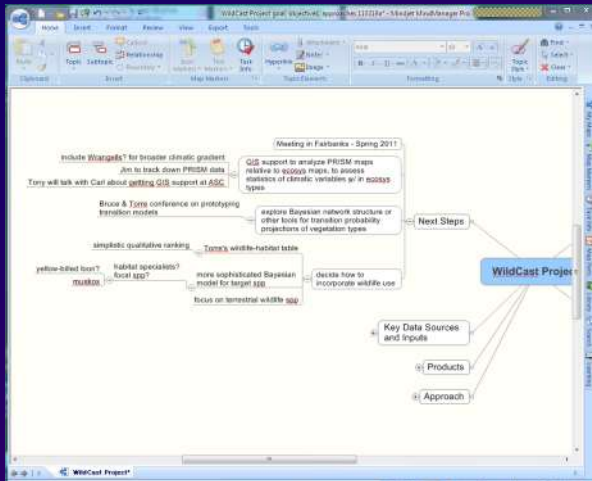
Riverine and Lowland Change, 2000-2100



Alpine Changes, 2000-2100



Bayesian Network Modeling



Factors

alder proximity,
seed production,
seed establishment,
growth rate,
soil drainage

Transition

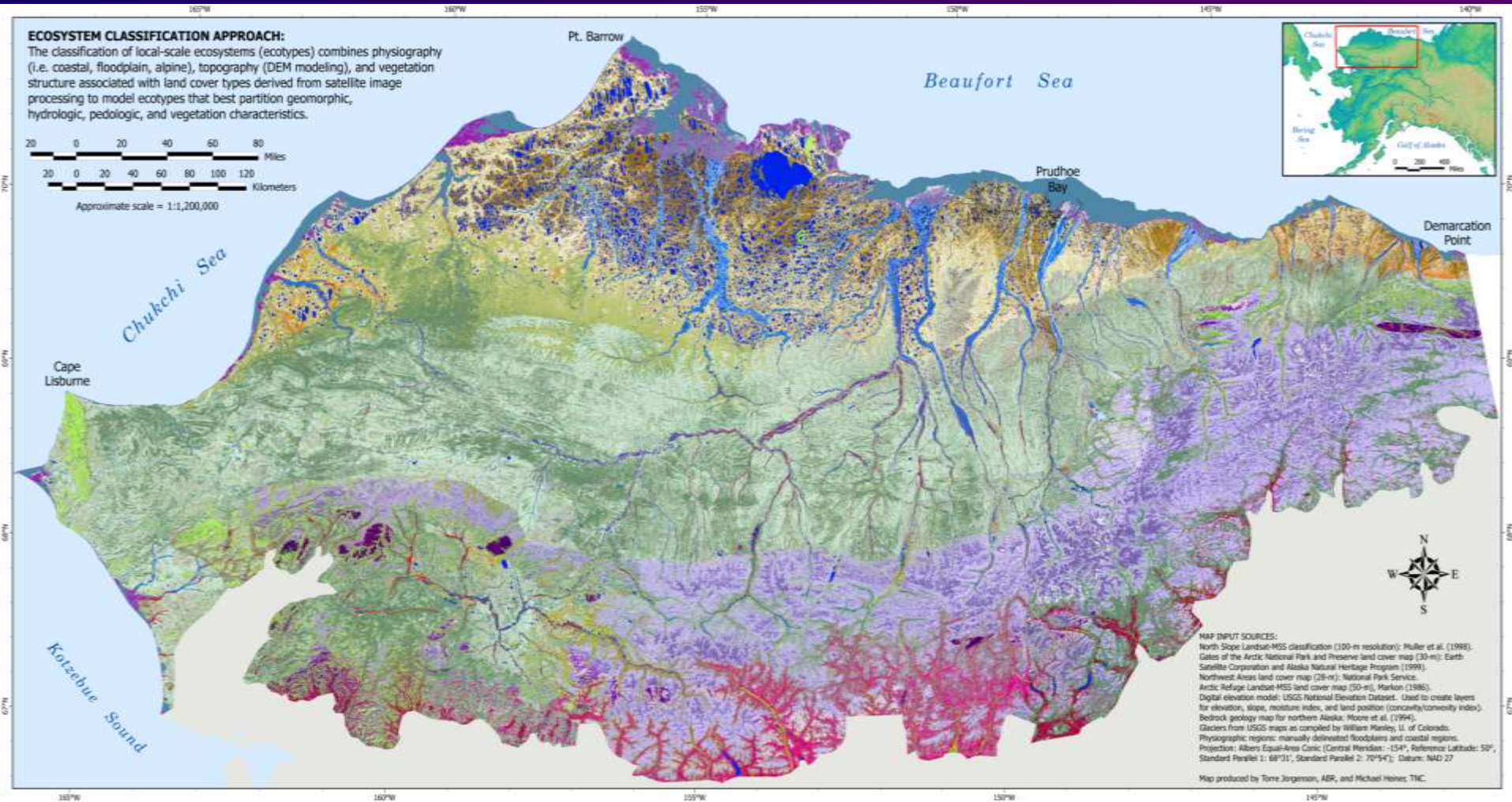
Upland
Dwarf Birch-
Tussock
Shrub

Upland Dwarf Birch-Tussock Shrub
Upland Birch-Ericaceous Low Shrub
Upland Alder-Willow Tall Shrub
Upland White Spruce Forest
Upland Barrens-Burned
Upland Barrens-Thermokarst
Lowland Lake
Coastal Water
Human Modified Barrens

Driver

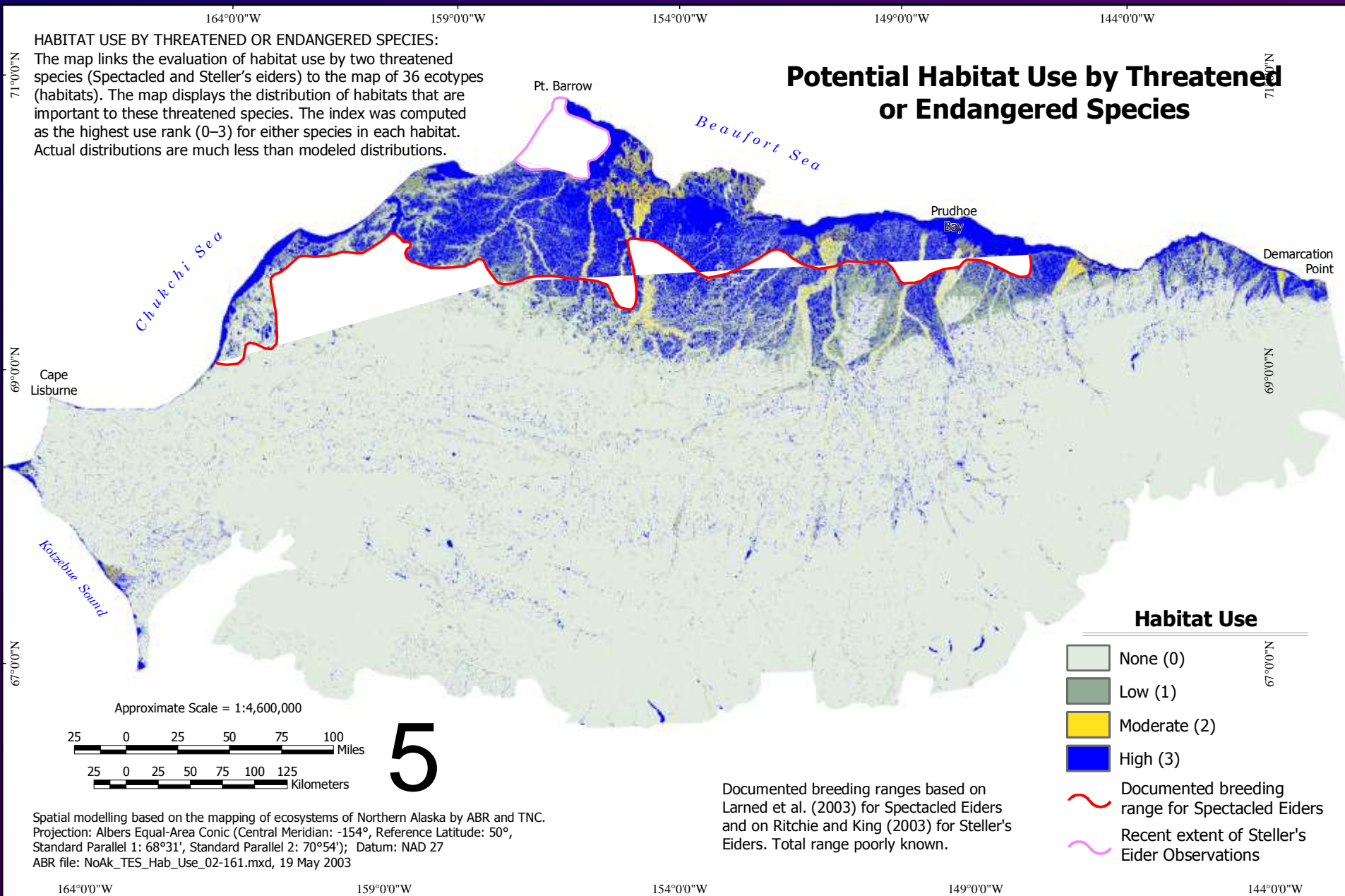
None
Dominance shift
Plant migration
Drainage/Migration
Fire
Thaw Slump
Thaw Lakes
Coastal erosion
Human development

From Habitats to Habitat Use



Ecosystems of Northern Alaska

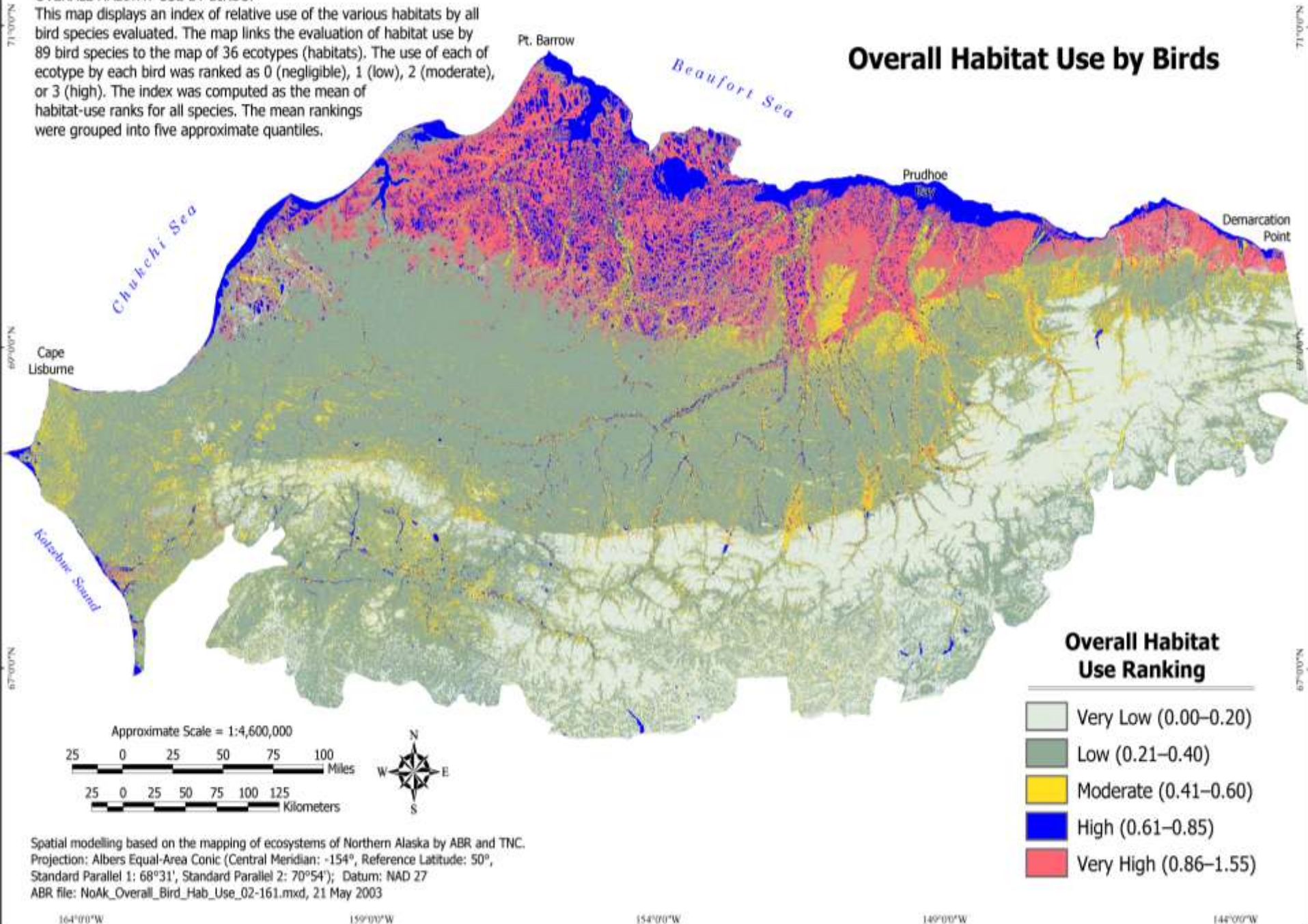
[illegible]



OVERALL HABITAT USE BY BIRDS:

This map displays an index of relative use of the various habitats by all bird species evaluated. The map links the evaluation of habitat use by 89 bird species to the map of 36 ecotypes (habitats). The use of each of ecotype by each bird was ranked as 0 (negligible), 1 (low), 2 (moderate), or 3 (high). The index was computed as the mean of habitat-use ranks for all species. The mean rankings were grouped into five approximate quantiles.

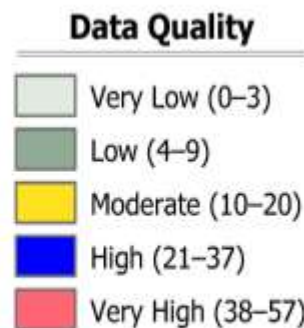
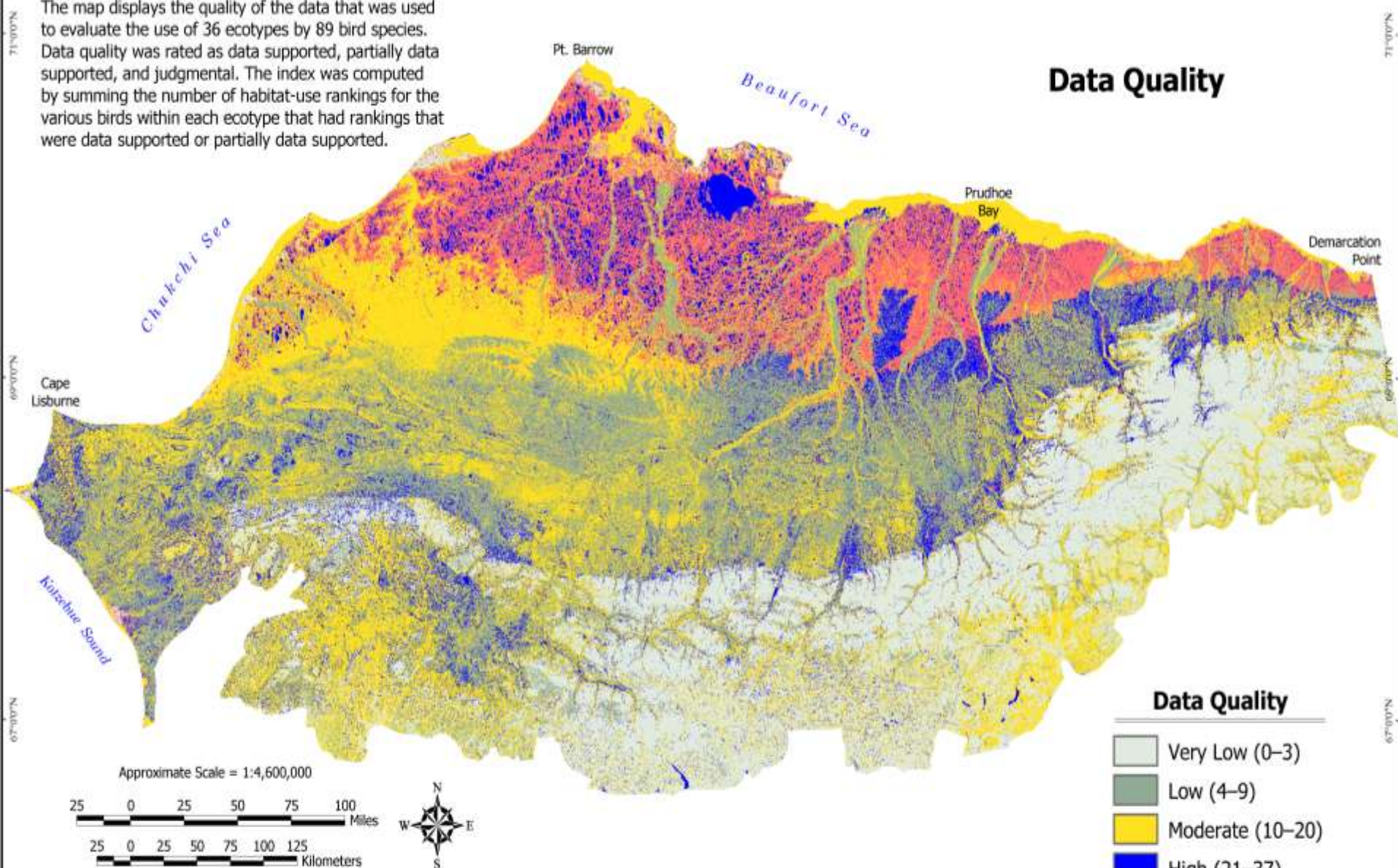
Overall Habitat Use by Birds



DATA QUALITY:

The map displays the quality of the data that was used to evaluate the use of 36 ecotypes by 89 bird species. Data quality was rated as data supported, partially data supported, and judgmental. The index was computed by summing the number of habitat-use rankings for the various birds within each ecotype that had rankings that were data supported or partially data supported.

Data Quality



Spatial modelling based on the mapping of ecosystems of Northern Alaska by ABR and TNC.
Projection: Albers Equal-Area Conic (Central Meridian: -154°, Reference Latitude: 50°,
Standard Parallel 1: 68°31', Standard Parallel 2: 70°54'); Datum: NAD 27
ABR file: NoAk_Data_Quality_Bird_Hab_Use_02-161.mxd, 21 May 2003

FUTURE EFFORTS

- **Refine transition probabilities with additional data compilation**
- **Develop proto-type spatial model for few select ecotypes**
- **Predict bird and mammal responses based on habitat availability**